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## POLICY RESEARCH WORKING PAPER

# Current Accounts in Debtor and Creditor Countries

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What is the current account response to a transitory income shock? This model predicts that favorable income shocks lead to current account deficits in debtor countries and current account surpluses in creditor countries.



## Summary findings

Kraay and Ventura reexamine a classic question in international economics: What is the current account response to a transitory income shock such as a temporary improvement in the terms of trade, a transfer from abroad, or unusually high production?

To answer this question, they construct a world equilibrium model in which productivity varies across

countries and international borrowing and lending take place to exploit good investment opportunities.

Despite its conventional ingredients, the model generates the novel prediction that favorable income shocks lead to current account deficits in debtor countries and current account surpluses in creditor countries. Evidence from thirteen OECD countries broadly supports this theoretical prediction.

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# Current Accounts in Debtor and Creditor Countries

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## Introduction

This paper reexamines a classic question in international economics: What is the current account response to a transitory income shock such as a temporary improvement in the terms of trade, a transfer from abroad or unusually high production? To answer this question, we construct a world equilibrium model in which productivity varies across countries and international borrowing and lending takes place to exploit good investment opportunities. Despite its conventional ingredients, the model generates the novel prediction that favourable income shocks lead to current account deficits in debtor countries and current account surpluses in creditor countries. Evidence from thirteen OECD countries broadly supports this prediction of the theory.

A simple thought experiment reveals how natural our result is as a benchmark case. Consider a country that receives a favourable transitory income shock. Suppose further that this country saves this shock and has two investment choices, domestic capital and foreign loans. To the extent that the shock does not affect the expected profitability of future investments at home and abroad, a reasonable guess is that investors allocate the marginal unit of wealth (the income shock) among assets in the same proportions as the average unit of wealth. Since by definition the share of a debtor country's wealth invested in domestic capital exceeds one, an increase in wealth (savings) results in a greater increase in domestic capital (investment), leading to a deficit on the current account (savings minus investment). Conversely, in creditor countries the increase in wealth exceeds investment at home, as a portion of this wealth increase is invested abroad. This produces a current account surplus in creditor countries.

The sharp result that comes out of this simple example follows from three assumptions. First, the income shock is saved. Second, investing in foreign capital is not an option for the country. Third, the marginal unit of wealth is allocated among assets as the average one is. We maintain the first two assumptions throughout the paper without (excessive) apologies. The first assumption is a basic tenet of consumption-smoothing models of savings. Despite some empirical failures of the simplest of these models, we feel the jury is still out regarding the relative importance of consumption-smoothing as a savings motive at the business cycle frequency that we focus on here.<sup>1</sup> The second assumption can be easily removed.<sup>2</sup> If we keep the other assumptions, a favourable income shock still leads to a current account deficit if and only if the share of domestic capital in the country's wealth exceeds one or, equivalently, if and only if foreign debt exceeds the stock of outward foreign investment. Otherwise a favourable income shock leads to a current account surplus.

The bulk of the theoretical effort of this paper is devoted to assessing the merit of the third assumption underlying our simple example, namely, that the marginal unit of wealth (savings) is invested in the same proportions as the stock of wealth. To do so, we construct a simple world equilibrium model in which productivity varies across countries and international borrowing and lending takes place to exploit good investment opportunities. In the model, we distinguish between production uncertainty and random changes in technology. In each date, some countries have "good" production functions that exhibit high average productivity, while other countries have "bad" production functions that exhibit low average

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<sup>1</sup> The importance of consumption-smoothing depends on the frequency of the data one is analyzing. It is obviously important for the analysis of quarterly data (most people spend more than they earn over Christmas and other holidays, and somewhat less than they earn in other times), and almost as surely is a bad theory for understanding savings rates over a quarter of a century. See Deaton (1992) for a survey of evidence on intertemporal models of savings.

<sup>2</sup> Moreover, this assumption is consistent with the strong home equity preference in OECD economies that has been documented by French and Poterba (1991) and Tesar and Werner (1992). Lewis (1995) surveys alternative explanations for this phenomenon.

productivity. In normal times, production functions do not change but output is uncertain. We use the term output shock to refer to production surprises. These shocks do not affect the probability distribution of future productivity and, as a result, they have only transitory income or wealth effects on investors. Occasionally, countries perform economic reforms or experience changes in their economic environment that change their “bad” production functions to “good” ones, or vice versa. These events have persistent effects on the average level of productivity, and we label them productivity shocks. Since productivity shocks change the probability distribution of future productivity, they both have income or wealth effects on investors, and also affect their investment strategies.

In our basic model, we assume that investors exhibit constant relative risk aversion and have no labour income. As a result, the shares of wealth invested in domestic capital and foreign loans depend only on asset characteristics, i.e. expected returns and volatilities. Since these are not affected by output shocks, we find that the marginal unit of wealth (the output shock) is invested as the average one is. Since countries with high productivity are debtors, we find that positive output shocks lead to current account deficits in these countries, and to current account surpluses in creditor countries. This distinction does not apply to productivity shocks. We find instead that favourable productivity shocks always lead to current account deficits, as investors react to the increase in the expected return to domestic capital by increasing their holdings of domestic capital and reducing their holdings of foreign loans. The usefulness of this benchmark model is that it highlights the set of assumptions that underlie our example: shocks have only transitory income effects, investors exhibit constant relative risk aversion, and there is no labour income.

We then proceed to relax these assumptions. First, we find that if relative risk aversion decreases with wealth, positive output shocks raise wealth and induce investors to take riskier investment positions. As a result, the share of the shock

invested in risky domestic capital exceeds its share in wealth. Second, we show that, if labour income is less risky than capital income, positive output shocks raise the ratio of financial to human wealth and hence expose the investor to greater risk. This induces investors to take safer investment positions in their financial wealth, and so the share of the shock invested in domestic capital falls short of its share in financial wealth. We obtain a simple rule to determine when a positive output shock leads to a current account deficit: the country's debt has to exceed a certain threshold that depends on how attitudes towards risk vary with wealth and the size of labour income. This threshold can be either positive or negative, and is zero in the case of constant relative risk aversion and no labour income.

Our research naturally relates to existing intertemporal models of the current account.<sup>3</sup> The early generation of intertemporal models, such as Sachs (1981,1982) Obstfeld (1982), Dornbusch (1983) and Svensson and Razin (1983), were designed to study the effects of terms of trade shocks and to develop rigorous theoretical foundations for the Harberger-Laursen-Metzler effect. We share with these models the notion that countries save transitory income shocks so as to smooth consumption over time. However, since these models abstract from capital accumulation, income shocks can only be invested in foreign loans. As a result they predict that positive transitory income shocks lead to current account surpluses in all countries.

Simply allowing for capital accumulation is not sufficient to obtain the main result of this paper, however. Subsequent contributions by Sachs (1981), Persson and Svensson (1985) and Matsuyama (1987) extended the early intertemporal models to include capital accumulation by investors with perfect foresight. These models were designed to analyze the current account response to persistent shocks

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<sup>3</sup> See Obstfeld and Rogoff (1995) for a survey of these models.



to the profitability of investment.<sup>4</sup> Since the assumption of perfect foresight implies that the return to investment is certain, arbitrage requires that the marginal product of capital equal the world interest rate. This condition, combined with the assumption of diminishing returns at the country level, uniquely determines the domestic stock of capital independently of the country's wealth. Hence, transitory income shocks which raise wealth but do not affect the marginal product of capital are again only invested in foreign loans, leading to current account surpluses in all countries.

One can understand our contribution as recognizing that investment risk has important implications for how the current account reacts to transitory income shocks. Once investment is modelled as a risky activity, the appropriate arbitrage condition equates the return on investment to the world interest rate *plus a risk premium*. Since the latter increases with the share of wealth held as risky domestic capital, transitory income shocks which do not affect the profitability of investment, but do raise wealth, must in part be invested in domestic capital for the arbitrage condition to be satisfied. In particular, we find that the share of the income shock that is invested in domestic capital exceeds the income shock itself in debtor countries, but not in creditor countries.<sup>5</sup>

The paper is organized as follows: Section 1 develops the basic model. Section 2 presents the main result of the paper. Section 3 explores the robustness of this result. Section 4 presents empirical evidence for thirteen OECD countries. Section 5 concludes.

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<sup>4</sup> These shocks correspond to our productivity shocks.

<sup>5</sup> Zeira (1987) provides an overlapping-generations model of a small open economy in which there is capital accumulation and investment risk. The latter arises from a stochastic depreciation rate. This model is used to show that cross-country differences in the rate of time preference could explain the Feldstein-Horioka finding that savings and investment are highly correlated in a cross-section of countries. Interestingly, he finds a U-shaped relationship between the steady-state level of debt of a country and its rate of time preference. He does not however explore the effects of transitory income shocks, as we do here.

## 1. A Model of International Borrowing and Lending

The world equilibrium model presented here is based on the view that international borrowing and lending results from differences in investment opportunities across countries rather than differences in the rate of time preference.<sup>6</sup> At each date, some countries have “good” production functions that exhibit high average productivity, while other countries have “bad” production functions that exhibit low average productivity. Investors in all countries are allowed to borrow and lend from each other at an interest rate  $r$ , which is determined in world equilibrium. We assume that the penalties for default are large enough that international loans are riskless. Firms own their capital stocks and are financed by sales of equity in stock markets. We assume that the cost of operating in foreign stock markets is high enough that only domestic investors and firms trade in the domestic stock market. This is an extreme, yet very popular device to generate the strong home-equity preference observed in real economies.<sup>7</sup>

We draw a distinction between production uncertainty and random changes in the state of technology. In normal times, countries have time-invariant but stochastic production functions. We use the term output shocks to refer to production surprises which occur during these normal times. Since these shocks do not affect the probability distribution of future productivity, they have only transitory income or wealth effects on investors. Occasionally, countries perform economic reforms or experience other changes in their economic environment that have persistent effects on their average level of productivity. We label these events as productivity shocks and model them as random changes in the production function.

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<sup>6</sup> See Buiter (1981) and cLarida (1990) for world equilibrium models in which borrowing and lending is motivated by cross-country variation in rates of time preference.

<sup>7</sup> See Obstfeld (1994) for a discussion of the effects of financial integration in a model similar to ours.

Since productivity shocks change the probability distribution of future productivity, they both have income or wealth effects on investors, and also affect their investment strategies.

A number of simplifications serve to highlight the bare essentials of our arguments. We consider a world with infinitely many atomistic countries, indexed by  $j=1,2,\dots$ . This allows us to rule out large-country effects and concentrate on the pure effects of international linkages. Also, we assume that there exists a single good which is used for consumption and investment. This device permits us to focus on intertemporal trade and eliminate the complications that arise from commodity trade. Finally, we restrict our analysis to the steady state of the model in which both world average growth and the interest rate are constant. This allows us to focus on the effects of country-specific shocks as opposed to global shocks. While these assumptions simplify the analysis considerably, we are convinced that removing them would not affect the thrust of our arguments.

## **Firms and Technology**

Production is random. Let  $q_j$  and  $k_j$  be the cumulative production and the stock of capital of the representative firm of country  $j$ . Also, define  $\pi_j$  as the state of technology of this country. Conditional on  $\pi_j$ , the production function of the representative firm is:

$$dq_j = \pi_j \cdot k_j \cdot dt + \sigma \cdot k_j \cdot d\theta_j \quad (1)$$

where  $\sigma$  is a positive constant and the  $\theta_j$ s are Wiener processes with  $E[d\theta_j]=0$  and  $E[d\theta_j^2]=dt$  and  $E[d\theta_j \cdot d\theta_m]=0$  if  $j \neq m$ . Equation (1) is simply a linear production function

which states that, conditional on the state of technology, the flow of output (net of depreciation) in country  $j$  is a normal random variable with instantaneous mean  $E[dq_j] = \pi_j \cdot k_j \cdot dt$  and variance-covariance matrix defined by  $E[dq_j^2] = \sigma^2 \cdot k_j^2 \cdot dt$  and  $E[dq_j \cdot dq_m] = 0$  if  $j \neq m$ . Realizations of the  $d\theta_j$ s are output shocks. Since these shocks do not change the probability distribution of future productivity, they have only income or wealth effects on the owners of the firm, but do not affect their investment strategies.

Average productivity varies across countries and over time. At each date, half of the countries are in a high-productivity regime,  $\pi_j = \bar{\pi}$ , while the other half are in a low-productivity regime,  $\pi_j = \underline{\pi}$ , with  $\underline{\pi} < \bar{\pi}$ . The dynamics of  $\pi_j$  follow a Poisson-directed process:

$$d\pi_j = \begin{cases} 0 & \text{with probability } 1 - \phi \cdot dt \\ g(\pi_j) & \text{with probability } \phi \cdot dt \end{cases} \quad (2)$$

where  $g(\pi_j) = \begin{cases} \underline{\pi} - \bar{\pi} & \text{if } \pi_j = \bar{\pi} \\ \bar{\pi} - \underline{\pi} & \text{if } \pi_j = \underline{\pi} \end{cases}$ ;  $\phi$ ,  $\underline{\pi}$  and  $\bar{\pi}$  are positive constants with  $\bar{\pi} - \underline{\pi} < \sigma^2$ ;

$E[d\pi_j \cdot d\theta_j] = 0$  and  $E[d\pi_j \cdot d\pi_m] = 0$  if  $j \neq m$ .<sup>8</sup> Equation (2) states that changes in regime are rare events (i.e. they occur with probability that goes to zero in the limit of continuous time) that are uncorrelated across countries and with the output shocks in Equation (1). Since the probability of a change in regime is small, productivity levels are persistent. Since high(low)-productivity countries expect productivity eventually to decline (increase), productivity levels also exhibit mean-reversion. Realizations of the  $d\pi_j$ s are productivity shocks. Since these shocks change the probability

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<sup>8</sup> Since there are infinitely many countries, each period a fraction  $\phi \cdot dt$  of the high(low)-productivity countries change regime. It follows that if half of the countries are initially in each regime, half of the countries will always be in each regime.

distribution of future productivity, they have both income or wealth effects on the owners of the firm, and they also affect their investment strategies.

There are many identical firms in each country with free access to existing technology. The representative firm is divided into  $k_j$  shares which have a (constant) value of one and deliver an instantaneous dividend equal to the flow of production per unit of capital. We assume that the realizations of past shocks and the probability distributions of the current shocks  $d\theta_j$  and  $d\pi_j$  are known by investors before production starts. However, the realizations of the contemporaneous shocks  $d\theta_j$  and  $d\pi_j$  are only known after production is completed and output is observed. Since investors must commit their resources before production starts, their investments are subject to uncertainty related to the contemporaneous realizations of the shocks. Since investors can freely trade equity after production is completed, their investments are not subject to uncertainty related to future realizations of the shocks. It follows that the return process perceived by investors is  $\pi_j \cdot dt + \sigma \cdot d\omega_j$ , where  $d\omega_j = \frac{d\pi_j}{\sigma} \cdot dt + d\theta_j$ . Therefore the expected return and volatility of holding a share of the representative firm are  $\pi_j$  and  $\sigma$ , respectively.<sup>9</sup>

## Consumption and Investment Strategies

Each country contains many identical consumer/investors with a logarithmic utility function:

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<sup>9</sup> Despite the fact that productivity shocks affect the return to investment, they do not contribute to the mean and variance of the return process since both they occur infrequently (with probability of order  $dt$ ) and they are small (with magnitude of order  $dt$ ).

$$E \int_0^{\infty} \ln c_j \cdot e^{-\rho t} \cdot dt \quad (3)$$

where  $c_j$  is the consumption of the representative consumer in country  $j$ . Let  $a_j$  and  $x_j$  be the wealth of this consumer and the share of wealth that is held in equity, respectively. We assume that  $a_j(0) > 0$  for all  $j$ . Then, the consumer's budget constraint is:

$$da_j = \left[ (\pi_j - r) \cdot x_j + r \right] \cdot a_j - c_j \cdot dt + \sigma \cdot x_j \cdot a_j \cdot d\omega_j \quad (4)$$

This budget constraint illustrates the standard risk-return trade-off behind investment decisions. If  $\pi_j > r$ , increases in the share of wealth allocated to equity raise the expected return to wealth by  $(\pi_j - r) \cdot a_j$ , at the cost of raising the volatility of this return by  $\sigma \cdot a_j$ . In Appendix 1, we show that the solution to the consumer's problem is:

$$c_j = \rho \cdot a_j \quad (5)$$

$$x_j = \frac{\pi_j - r}{\sigma^2} \quad (6)$$

Equation (5) states that consumption is a fixed fraction of wealth and is independent of asset characteristics i.e.  $r$ ,  $\pi_j$  and  $\sigma$ . This is the well-known result that income and substitution effects of changes in asset characteristics cancel for logarithmic consumers. Equation (6) shows that the share of wealth allocated to each asset depends only on asset characteristics, i.e.  $r$ ,  $\pi_j$  and  $\sigma$ , and not on the level of wealth,  $a_j$ . This is nothing but the simple investment rule we used in the example in the introduction.

## World Equilibrium

To find the world interest rate, we use the market-clearing condition for international loans,  $\sum_j (a_j - k_j) = 0$ , and the investment rule in Equation (6) to obtain:

$$r = \pi - \sigma^2 \quad (7)$$

where  $\pi = \lim_{J \rightarrow \infty} \frac{1}{J} \cdot \sum_{j=1}^J \pi_j \cdot \frac{a_j}{\lim_{J \rightarrow \infty} \frac{1}{J} \cdot \sum_{j=1}^J a_j}$ . In Appendix 1 we show that there exists a

steady-state in which both the world growth rate and the world average productivity are constant. In what follows, we assume that the world economy is already in this steady state.

Using the world interest rate in Equation (7) and the investment rule in Equation (6) we find that the world distribution of capital stocks is given by:

$$k_j = \left( 1 + \frac{\pi_j - \pi}{\sigma^2} \right) \cdot a_j \quad (8)$$

Equation (8) states that the capital stock of a country is increasing in both its wealth and its productivity. Interestingly, this world of stochastic linear economies does not generate the usual corner solution of a world of deterministic linear economies in which all the capital is located in the country or countries that have the highest

productivity. In the presence of investment risk, these extreme investment strategies are ruled out by investors as excessively risky. In fact, since we have assumed that productivity differences are not too large relative to the investment risk, i.e.

$\bar{\pi} - \underline{\pi} < \sigma^2$ , all countries hold positive capital stocks in equilibrium.

Although world average growth is constant, this world economy exhibits a rich cross-section of growth rates. To see this, substitute Equations (5)-(7) into (4), to find the stochastic process for wealth:

$$\frac{da_j}{a_j} = \left[ \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right)^2 + \pi - \sigma^2 - \rho \right] \cdot dt + \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right) \cdot d\omega_j \quad (9)$$

The growth rate consists of the return to the country's wealth minus the consumption to wealth ratio. The first term in Equation (9) is the average or expected growth rate, and is larger in high-productivity countries, since these countries obtain a higher average return on their wealth. The second term in Equation (9) is the unexpected component in the growth rate, and is more volatile in high-productivity countries, since these countries hold a larger fraction of their wealth in risky capital.



## 2. Determinants of the Current Account

The model developed above describes a world equilibrium in which high-productivity countries borrow from low-productivity countries since the former have access to better investment opportunities than the latter. The amount that high-productivity countries borrow is limited only by their willingness to bear risks. To see this, let  $f_j$  be the net foreign assets of country  $j$ , i.e.  $f_j = a_j - k_j$ , and use Equation (8) to find that:

$$f_j = -\frac{\pi_j - \bar{\pi}}{\sigma^2} \cdot a_j \quad (10)$$

Since  $\underline{\pi} \leq \pi \leq \bar{\pi}$ , high-productivity countries are debtors,  $f_j < 0$ , while low-productivity countries are creditors,  $f_j > 0$ . Equation (10) shows that, for a given level of investment risk, the volume of borrowing and lending is larger the larger are the cross-country productivity differentials. Also note that, for a given productivity differential, the volume of borrowing is larger the lower is the investment risk. Finally, observe that a country can move from lender to borrower (borrower to lender) if and only if it experiences a positive (negative) productivity shock.<sup>10</sup>

Next we examine the behavior of the current account in this world equilibrium. First, we derive the stochastic process for the current account and comment on its salient features. Second, we provide an intuition as to the main economic forces that

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<sup>10</sup> In this world, a sudden and large current account deficit that turns a country from creditor to debtor should be seen as a positive development. This notion is clearly at odds with widely-held beliefs in policy circles.

determine how the current account responds to shocks. Throughout, we emphasize the differences in the current account between debtor and creditor countries.<sup>11</sup>

## Current Account Patterns

Since the current account is the change in net foreign assets, i.e.  $df_j$ , we apply Ito's lemma to (10) and use Equation (9) to find the following stochastic process for foreign assets:

$$df_j = \left[ \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right)^2 + \pi - \sigma^2 - \rho \right] \cdot f_j \cdot dt + \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right) \cdot f_j \cdot d\omega_j + f_j \cdot \frac{d\pi_j}{\pi_j - \pi} \quad (11)$$

Equation (11) states that net foreign assets follow a mixed jump-diffusion process and provides a complete characterization of their dynamics as a function of the forcing processes  $d\theta_j$  and  $d\pi_j$  (remember that  $d\omega_j = \frac{d\pi_j}{\sigma} \cdot dt + d\theta_j$ ), and all the parameters of the model  $\sigma$ ,  $\rho$ ,  $\phi$ ,  $\pi$  and  $\bar{\pi}$ .

Consider first the prediction of the model for the average or expected current account in debtor and creditor countries. Taking expectations of (11) yields:

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<sup>11</sup> The reader might ask why emphasize the debtor/creditor distinction instead of the high/low productivity distinction. There are two reasons. From a theoretical viewpoint, one could defend this choice by pointing out that the debtor/creditor distinction is more robust. In our model, only cross-country differences in average productivity determine whether a country is a debtor or a creditor. If we assume, for instance, that high average productivity is associated with high volatility in production, it is then possible that the high-productivity technology might be unappealing enough to turn high-productivity countries into creditors (see Devereaux and Saito (1997)). In this case, all the results presented in this paper would still hold true for the debtor/creditor distinction, but not for the high/low productivity distinction. From an empirical viewpoint and anticipating that the predictions of the model will be confronted with the data, one could defend the use of the debtor/creditor distinction based on the observation that existing measures of net foreign asset positions of countries are of much better quality than those of their average productivity.

$$E[df_j] = \left[ \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right)^2 + \pi - \sigma^2 - \rho \right] \cdot f_j \cdot dt + \frac{\phi \cdot g(\pi_j)}{\pi_j - \pi} \cdot f_j \cdot dt \quad (12)$$

Equation (12) separates the expected current account into two pieces, which capture the effects of expected savings and expected changes in asset returns, respectively. The first term reflects consumption “tilting” by agents. If the expected return to wealth exceeds (does not exceed) the rate of time preference, i.e.

$\left( \sigma + \frac{\pi_j - \pi}{\sigma} \right)^2 + \pi - \sigma^2 > (<) \rho$ , consumers will find it optimal to save (dissave) so as

to “tilt” their consumption profile. These savings or dissavings are allocated across assets in the same proportions as the existing stock of wealth. *Ceteris paribus*, this means that, in growing economies, debtors countries on average run current account deficits, while creditors have surpluses on average. The opposite is true in economies with negative growth. The second term in Equation (12) captures the effects of mean reversion in productivity. Since productivity in debtor countries is above its long-run average, it is expected to decline, while the converse is true for creditor countries. Reductions (increases) in productivity induce investors to reduce (increase) their holdings of capital and instead lend (borrow from) abroad. *Ceteris paribus*, this means that debtor countries on average experience current account surpluses, while creditor countries on average experience deficits. The balance of the two effects is ambiguous in growing economies, and depends on all the parameters of the model. The faster the economy grows and the smaller the mean-reverting component of productivity is, the more likely it is that on average debtors run current account deficits and creditors run current account surpluses.

Both output and productivity shocks contribute to the variance of the current account. To see this, note that it follows from Equation (11) and the definitions of the shocks that:

$$\text{Var} [df_j] = \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right)^2 \cdot f_j^2 \cdot dt + \left( \frac{g(\pi_j)}{\pi_j - \pi} \right)^2 \cdot \phi \cdot f_j^2 \cdot dt \quad (13)$$

In normal times (i.e. with probability close to one)  $d\pi_j=0$  and fluctuations in the current account are driven by the output shocks. These shocks have small effects (of order  $dt^{1/2}$ ) but occur with high probability (of order 1). Their contribution to the variance of the current account is captured by the first term of Equation (13). At some infrequent dates (i.e. with probability close to zero)  $d\pi_j \neq 0$  and the behavior of the current account is dominated by productivity shocks. Although these shocks occur with small probability (of order  $dt$ ), they do have large effects on the current account (of order 1) since they induce a reallocation of investors' portfolios. Their contribution to the variance of the current account is captured by the second term of Equation (13).

### The Current Account Response to Shocks

We are now ready to examine perhaps the most novel finding of this paper, that the response of the current account to an output shock depends on whether a country is a debtor or a creditor. This result follows directly from Equation (11).

Since  $\sigma + \frac{\pi_j - \pi}{\sigma} > 0$ , a positive output shock, i.e.  $d\theta_j > 0$ , leads to a current account deficit in debtor countries and a current account surplus in creditor countries. To develop an intuition for this result, we focus on the savings-investment balance.

The permanent-income consumers who populate our world economy save in order to smooth their consumption over time. Since the output shock represents a transitory increase in income, it is saved (recall Equation (9)). This is true regardless of whether a country is a debtor or a creditor, and is a typical feature of intertemporal models of the current account.

Having decided to save the output shock, investors must then decide how to allocate these additional savings between domestic equity and foreign loans. We depart from previous intertemporal models of the current account in how we model this decision. Since the investor's desired holdings of equity are equal to the country's stock of capital in equilibrium, Equation (6) can be interpreted in terms of a familiar arbitrage condition:

$$\pi_j = r + \sigma^2 \cdot \frac{k_j}{a_j} \quad (14)$$

Equation (14) states that expected rate of return to equity,  $\pi_j$ , must equal the world interest rate,  $r$ , plus the appropriate risk or equity premium,  $\sigma^2 \cdot (k_j/a_j)$ . In this world of logarithmic investors, this risk premium is nothing but the covariance between the return to equity and the return to the investors' wealth. The larger is the share of domestic capital in investors' wealth, the larger is this covariance and the larger is the risk premium that investors require to hold the marginal unit of equity. The additional savings that result from the output shock allow investors to increase their holdings of risky domestic equity without increasing the risk of their portfolios, provided that they keep the share of equity in their portfolios constant. Thus, the marginal unit of wealth (the output shock) is invested in the same proportions as the average one. Since by definition the share of a debtor country's wealth devoted to domestic capital exceeds one, an increase in wealth (savings) results in a greater increase in domestic capital (investment), leading to a deficit on the current account.

Conversely, in creditor countries the increase in wealth exceeds investment at home, as a portion of this wealth increase is invested abroad. This produces a current account surplus in creditor countries.

This discussion emphasizes the importance of allowing for investment risk in predicting the current account response to an output shock. To the extent that this form of uncertainty is important, existing models of the current account that assume investment is a riskless activity, or else abstract entirely from capital accumulation, provide a misleading description of how the current account responds to output shocks.<sup>12</sup>

We now turn to the response of the current account to productivity shocks.

First, since  $\sigma + \frac{\pi_j - \pi}{\sigma} > 0$ , the second term of Equation (11) shows that a positive productivity shock, i.e.  $d\pi_j > 0$ , generates an income effect that leads to a current account deficit in debtor countries and a current account surplus in creditor countries. This effect is formally equivalent to that of an output shock and requires no further discussion.

Second, a productivity shock has a rate-of-return effect on investment since it changes the probability distribution of future productivity.<sup>13</sup> When a creditor (debtor) country receives a positive (negative) productivity shock, the expected return to equity increases (falls). This induces investors to hold a larger (smaller) fraction of their portfolio in domestic equity and, as result, generates an investment boom

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<sup>12</sup> The large equity premium observed in the data suggests that investment risk is an important feature of real economies. A prediction of this model is that this equity premium,  $\sigma^2 + \pi_j - \pi$ , should be larger in debtor countries. To the best of our knowledge, this result is new and has not been tested yet.

<sup>13</sup> As Equation (5) shows, income and substitution effects of changes in the expected return to equity cancel in our world of logarithmic consumers. In models with more general preferences these rate-of-return effects of productivity shocks could be associated with consumption booms or busts, depending on the balance of their income and substitution effects.

(bust). The counterpart of this investment response is a current account deficit (surplus) and is reflected in the third term of Equation (11). Since rate-of-return effects of productivity shocks consist of reallocations in the stocks of assets, their effects on the current account are much larger (of order 1) than the income effects of the same shocks (of order  $dt$ ).<sup>14</sup> Since productivity shocks are infrequent but have large effects, they would show up as large spikes in a time series of the current account.

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<sup>14</sup> And, for that matter, much larger than the income effects of output shocks (of order  $dt^{1/2}$ ).

### 3. Investment Strategies

The theory developed above predicts that the current account response to output shocks is different in debtor and creditor countries. Instrumental in deriving this result were our assumptions regarding how investors trade risk and return. These assumptions ensured that the marginal and average propensities to invest in foreign loans coincide. However, there is a long and distinguished literature that analyzes how optimal investment strategies depend on attitudes towards risk, the size and stochastic properties of labour income and the correlation between asset returns and changes in the investment opportunity set and other aspects of the investor's environment.<sup>15</sup> A general finding of this literature is that one should not expect that marginal and average propensities to invest coincide.

The purpose of this section is to show that a modified version of our result holds in a generalized model that allows attitudes towards risk to vary with the level of wealth and introduces riskless labour income.<sup>16</sup> In the generalized model presented here, marginal and average propensities to invest in foreign loans differ. However, we find a simple rule which determines when a positive output shock leads to a current account deficit: the country's debt has to exceed a threshold that depends on (1) how attitudes towards risk vary with wealth, and (2) the size of labour income. This threshold can be either positive or negative, and is zero in the benchmark case of constant relative risk aversion and no labour income. We therefore have the modified result that favourable output shocks lead to current

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<sup>15</sup> See Merton (1995) for an overview of this research, and Bodie, Merton and Samuelson (1992) for an example with risky labour income.

<sup>16</sup> We do not explore the implications for our argument that arise from the possibility that asset returns be correlated with changes in the investors' environment. These correlations give rise to a hedging component in asset demands that greatly depends on the specifics of the model.



account deficits in sufficiently indebted countries. Otherwise, they lead to current account surpluses.

## Two Extensions

To allow attitudes toward risk to vary with the level of wealth, we adopt the following Stone-Geary utility function:

$$E \int_0^{\infty} \ln(c_j + \beta_j) \cdot e^{-\rho t} \cdot dt \quad (15)$$

where the  $\beta_j$ s are constants, possibly different across countries. The coefficient of relative risk aversion, i.e.  $\frac{c_j}{c_j + \beta_j}$ , varies across countries and over time, as follows.

For a given level of consumption or wealth, risk aversion is decreasing in  $\beta_j$ . More important for our purposes, if  $\beta_j < 0$  ( $\beta_j > 0$ ), investors exhibit decreasing (increasing) relative risk aversion as their level of consumption increases.<sup>17</sup>

To introduce labour income, we assume that there is an additional technology that uses labour to produce the single good.<sup>18</sup> Normalizing the labour force of each country to one, the flow of output produced using the second technology is given by  $\lambda_j \cdot dt$ . Labour productivity,  $\lambda_j$ , is assumed to be constant although it might vary across countries. Workers are paid a wage equal to the value

<sup>17</sup> As is well-known, consumers with Stone-Geary preferences might choose negative consumption. We ignore this in what follows.

<sup>18</sup> The assumption of an aggregate linear technology between labour and capital is much less restrictive than it might seem at first glance. It arises naturally in models where some form of factor-price-equalization theorem holds. One could, for example, use the model in Ventura (1997) to endogenously generate a linear technology. We do not do so here to save notation.

of their marginal product, i.e.  $\lambda_j \cdot dt$ . The existence of labour income complicates only slightly the consumer's budget constraint:

$$da_j = \left[ \left( (\pi_j - r) \cdot x_j + r \right) \cdot a_j + \lambda_j - c_j \right] \cdot dt + x_j \cdot a_j \cdot \sigma \cdot d\omega_j \quad (16)$$

To ensure that all countries hold positive capital stocks in equilibrium, we assume

$$\text{that } a_j(0) > \frac{\lambda_j + \beta_j}{\pi - \sigma^2}.$$

The representative consumer residing in country  $j$  maximizes (15) subject to the budget constraint (16) and the (correct in equilibrium) belief that  $r$  is constant and  $\pi_j$  follows the dynamics in Equation (2). In Appendix 1, we show that the solution to this generalized consumer's problem is:

$$c_j = \rho \cdot \left( a_j + \frac{\lambda_j + \beta_j}{r} \right) - \beta_j \quad (17)$$

$$x_j = \left( 1 + \frac{\lambda_j + \beta_j}{r \cdot a_j} \right) \cdot \frac{\pi_j - r}{\sigma^2} \quad (18)$$

Equations (17) and (18) illustrate how optimal consumption and investment rules depend on both attitudes towards risk and the presence of labour income. Note first that if consumers exhibit constant relative risk aversion,  $\beta_j=0$ , and there is no labour income,  $\lambda_j=0$ , Equations (17) and (18) reduce to the consumption and investment rules of the previous model (Equations (5) and (6)). As before, consumption is linear in wealth and income and substitution effects of changes in the expected return to equity cancel. Equation (18) shows that the share of wealth devoted to equity decreases with wealth if and only if  $\lambda_j + \beta_j > 0$ . To interpret this condition, note first that if  $\beta_j > 0$ , consumers exhibit increasing relative risk aversion, and so choose to allocate

a smaller share of wealth to risky domestic capital as their wealth increases. Second, note that in the presence of riskless labour income,  $\lambda_j > 0$ , increases in financial wealth raise the ratio of financial to human wealth, and, ceteris paribus, expose the investor to greater risk. In response, agents adopt less aggressive investment strategies, and the share of financial wealth devoted to risky domestic capital falls. Finally, holding constant the level of wealth, investors with low relative risk aversion, i.e. high values of  $\beta_j$ , and/or a relatively large stream of riskless labour income, i.e. high values of  $\lambda_j$ , will devote a larger share of their wealth to risky domestic capital.

## World Equilibrium

To compute the world equilibrium interest rate, we impose once again the market-clearing condition for international loans,  $\lim_{J \rightarrow \infty} \frac{1}{J} \cdot \sum_{j=1}^J a_j - k_j = 0$  and use the investment rule (18) to find that Equation (7) is still valid. Appendix 1 shows that, if  $\lim_{J \rightarrow \infty} \frac{1}{J} \cdot \sum_{j=1}^J \lambda_j + \beta_j = 0$ , there exists a steady-state in which both the world growth rate and world average productivity are constants. In what follows, we assume that this restriction regarding the cross-country distribution of parameters is satisfied and that the world economy is in the steady state.

The world distribution of capital stocks is now given by a straightforward generalization of Equation (8):

$$k_j = \left( a_j + \frac{\lambda_j + \beta_j}{\pi - \sigma^2} \right) \cdot \left( 1 + \frac{\pi_j - \pi}{\sigma^2} \right) \quad (19)$$

As before, the capital stock of a country is increasing in both its productivity and wealth, and moreover, the world distribution of capital stocks is non-degenerate since the restrictions that  $a_j(0) > \frac{\lambda_j + \beta_j}{\pi - \sigma^2}$  and  $\bar{\pi} - \underline{\pi} < \sigma^2$ , jointly ensure that all countries hold positive capital stocks in equilibrium.<sup>19</sup> In addition, countries whose residents have a high tolerance for risk and/or high labour productivity, i.e. high  $\beta_j$  and/or  $\lambda_j$ , have large domestic capital stocks.

We find, once more, that while the world average growth rate is constant, the world economy exhibits a rich cross-section of growth rates. To see this, substitute Equations (17)-(18) and (7) into the budget constraint in Equation (16) to obtain:

$$\frac{da_j}{a_j} = \left[ \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right)^2 + \pi - \sigma^2 - \rho \right] \cdot \left( 1 + \frac{\lambda_j + \beta_j}{a_j \cdot (\pi - \sigma^2)} \right) \cdot dt + \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right) \cdot \left( 1 + \frac{\lambda_j + \beta_j}{a_j \cdot (\pi - \sigma^2)} \right) \cdot d\omega_j \quad (20)$$

As before, high productivity countries grow faster and experience more volatile growth than low productivity countries. Perhaps the most interesting difference between this growth rate and the special case in Equation (9) is that, if  $\lambda_j + \beta_j > 0$  ( $\lambda_j + \beta_j < 0$ ), both the growth rate of a country and the volatility of the growth rate decline (increase) with the level of wealth. This is a consequence of the investment strategy described in Equations (18). If  $\lambda_j + \beta_j > 0$  ( $\lambda_j + \beta_j < 0$ ), investors invest a smaller (larger) share of their wealth to risky domestic capital as their wealth increases, lowering (raising) both the expected return on their wealth and the volatility of that return.

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<sup>19</sup> The first parameter restriction ensures the first parentheses in Equation (19) is positive.

## Determinants of the Current Account

We are now ready to examine the behaviour of the current account in this more general model. The world distribution of loans is given by the following generalization of Equation (10):

$$f_j = -\frac{\pi_j - \pi}{\sigma^2} \cdot a_j - \frac{\lambda_j + \beta_j}{\pi - \sigma^2} \cdot \left(1 + \frac{\pi_j - \pi}{\sigma^2}\right) \quad (21)$$

As before, the model describes a world equilibrium in which, conditional on the level of wealth, high-productivity countries borrow from low-productivity countries in order to take advantage of better investment opportunities at home. This is reflected in the first term in Equation (21). In addition, the international pattern of borrowing and lending reflects cross-country differences in attitudes towards risk and the characteristics of labour income across countries. Countries populated by investors who have a high (low) tolerance for risk and/or a large (small) stream of riskless labour income  $\lambda_j + \beta_j > 0$  ( $\lambda_j + \beta_j < 0$ ) are, ceteris paribus, more likely to be debtors.

We find the current account by applying Ito's lemma to Equation (21) and using Equations (17) and (20) :

$$df_j = \left[ \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right)^2 + \pi - \sigma^2 - \rho \right] \cdot \left( f_j + \frac{\lambda_j + \beta_j}{\pi - \sigma^2} \right) \cdot dt + \left( \sigma + \frac{\pi_j - \pi}{\sigma} \right) \cdot \left( f_j + \frac{\lambda_j + \beta_j}{\pi - \sigma^2} \right) \cdot d\omega_j + \left( f_j + \frac{\lambda_j + \beta_j}{\pi - \sigma^2} \right) \cdot \frac{d\pi_j}{\pi_j - \pi} \quad (22)$$

The current account again follows a mixed jump-diffusion process, with dynamics that can be completely characterized in terms of the underlying shocks,  $d\theta_j$  and  $d\pi_j$ ,

and all the parameters of the model,  $\sigma$ ,  $\rho$ ,  $\phi$ ,  $\underline{\pi}$ ,  $\bar{\pi}$ ,  $\lambda_j$  and  $\beta_j$ . Since we have assumed that  $\lim_{j \rightarrow \infty} \frac{1}{j} \cdot \sum_j \lambda_j + \beta_j = 0$ , the results of the previous section may be thought of as describing the determinants of the current account for an average or “typical” country where  $\lambda_j + \beta_j = 0$ . Comparing Equations (22) and (11), we see that they are identical provided that we replace  $f_j$  with  $f_j + \frac{\lambda_j + \beta_j}{\pi - \sigma^2}$ . Thus, all of the results in Section 2 generalize in a straightforward manner provided that this modified definition of debt is used. Accordingly, we restrict ourselves here to a brief discussion of the additional insights obtained from the more general model regarding the response of the current account to output shocks.

Since  $\sigma + \frac{\pi_j - \pi}{\sigma} > 0$ , Equation (21) shows that a positive output shock, i.e.

$d\theta_j > 0$ , leads to a current account deficit in countries where  $f_j + \frac{\lambda_j + \beta_j}{\pi - \sigma^2} < 0$  and a

surplus in countries where  $f_j + \frac{\lambda_j + \beta_j}{\pi - \sigma^2} > 0$ . This result is again best understood in

terms of the savings-investment balance. As in the model of the previous section, savings behaviour is very standard and reflects the desire of agents to smooth their consumption in the face of transitory income shocks. Where our results differ from the existing current account literature is in how these savings are allocated across assets. Rearranging Equation (18), we obtain the following generalization of the arbitrage condition in Equation (14).

$$\pi_j = r + \sigma^2 \cdot \frac{k_j}{a_j} \cdot \frac{(\pi - \sigma^2) \cdot a_j}{(\pi - \sigma^2) \cdot a_j + \lambda_j + \beta_j} \quad (23)$$

The risk premium is the product of two terms. The first is the covariance between the return on equity and the return on an investor's portfolio, which is greater the larger is the volatility of equity returns and the larger is the share of wealth invested in domestic equity,  $\sigma^2 \cdot (k/a_j)$ . The second term is the coefficient of relative risk aversion

of the investor's value function,  $\frac{(\pi - \sigma^2) \cdot a_j}{(\pi - \sigma^2) \cdot a_j + \lambda_j + \beta_j}$ .<sup>20</sup> In the model of the previous

section  $\lambda_j + \beta_j = 0$  and this coefficient was equal to one. In this more general setting, it depends on both attitudes towards risk and the relative importance of riskless labour income. Most important for our results is that this term is decreasing (increasing) in wealth provided that  $\lambda_j + \beta_j < 0$  ( $\lambda_j + \beta_j > 0$ ). Suppose now that a country experiences a positive output shock that raises investors' wealth. If the marginal unit of wealth is invested in exactly the same proportions as the average unit, the overall risk premium falls (rises) if  $\lambda_j + \beta_j < 0$  ( $\lambda_j + \beta_j > 0$ ), and Equation (23) no longer holds. Hence, for the arbitrage condition to be satisfied, the marginal unit of wealth invested in risky domestic capital must exceed (be less than) the average unit.

This result qualifies the relationship between debt and the response of the current account to output shocks. If  $\lambda_j + \beta_j < 0$  ( $\lambda_j + \beta_j > 0$ ), a country may be a creditor (debtor) and yet experience a current account deficit (surplus) in response to a favourable income shock. If relative risk aversion decreases with wealth, positive output shocks that raise wealth induce investors to take riskier investment positions. As a result, the share of the marginal unit of wealth invested in risky domestic capital exceeds its share in average wealth. Depending on the magnitude of this effect, some creditor countries might run current account deficits. Since labour income is less risky than capital income, positive output shocks raise the ratio of financial to

<sup>20</sup> The coefficient of relative risk aversion of the value function tells us how the consumer values different lotteries in wealth, as apposed to the coefficient of relative risk aversion of the utility function, which tells us how the consumer values different lotteries over consumption. The latter depends only on preferences, while the former depends on both preferences and other aspects of the consumers' environment.

human wealth and hence expose the investor to greater risk. This induces investors to take safer investment positions in their financial wealth, and so the share of the shock invested in domestic capital falls short of its share in financial wealth. Hence, some debtor countries might run current account surpluses in response to a favourable output shock.

In summary, we find a simple rule to determine the response of the current account to a favourable output shock. If the level of debt exceeds the following threshold  $-f_j > \frac{\lambda_j + \beta_j}{\pi - \sigma^2}$ , then favourable output shocks lead to a current account deficit. Otherwise, they lead to a current account surplus. This threshold can be positive or negative, and in the special case of the previous sections is equal to zero. Finally, note that using Equation (21) we can rewrite this condition as  $\pi_j > \pi$ . That is, high-output shocks lead to current account deficits in high-productivity countries and current account surpluses in low-productivity countries.<sup>21</sup>

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<sup>21</sup> Once again, remember that this is a consequence of our assumption that there are no differences across countries in volatilities. See footnote 11.



## 4. Empirical Evidence

In this section, we present some preliminary empirical evidence that broadly supports the theory developed above. This evidence is not intended as a formal test of the theory, but rather as suggestive that we are capturing some aspects of the behaviour of the current account in the real world. We begin by assuming that  $\lambda_j + \beta_j$  and  $\pi_j$  are unobservable. Hence, the threshold level of debt above which output shocks lead to current account deficits cannot be observed. Under this assumption, the content of our theory can be understood as a probabilistic statement that the higher is the level of debt of the country, the more likely favourable output shocks lead to current account deficits.<sup>22</sup> We take per capita GNP growth as an imperfect measure of the shocks emphasized by the theory. This measure is imperfect since it does not distinguish between output and productivity shocks. Yet to the extent that output shocks are present in the data, we would expect to find that the correlation of the current account with per capita GNP growth is smaller in countries with higher levels of debt. Accordingly, we study how this correlation varies with the level of debt of a country.

### Data

For our empirical work, we require appropriate measures of debt and the current account. We construct a measure of debt using data on the international investment positions (IIPs) of OECD economies as reported in the International Monetary Fund's Balance of Payments Statistics Yearbook. The IIP is a compilation

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<sup>22</sup> The unconditional probability of an output shock leading to a current account deficit is  $\Pr(\lambda_j + \beta_j > -r \cdot f_j) = \Pr(\pi_j > \pi) = 1/2$ . However, conditional on the level of debt of the country and for any distribution of  $\lambda_j + \beta_j$ , this probability is  $\Pr(\lambda_j + \beta_j > -r \cdot f_j | f_j)$  which is increasing in  $f_j$ .

of estimates of stocks of assets corresponding to the various flow transactions in the capital account of the balance of payments, valued at market prices. We measure debt as minus one times the net holdings of public and private bonds, and other long- and short-term capital of the resident official and non-official sectors, expressed as a ratio to GNP. However, as noted in the introduction, this measure of debt cannot be used to infer the share of wealth held as claims on domestic capital, since it does not take into account the fact that the countries in our sample can hold their wealth in three forms: debt, domestic capital, and capital located abroad. Accordingly, we subtract outward foreign direct investment and holdings of foreign equity by domestic residents from debt to arrive at an "adjusted debt" measure. Figure A1 plots the time series for debt and adjusted debt for the thirteen OECD economies for which we are able to construct these variables.<sup>23</sup> Table 1 presents an overview of the data for the sample of 13 OECD countries for which it is possible to construct adjusted debt measures. The first column reports the net external debt of country  $j$ , expressed as a fraction of GNP, while the second column reports the holdings of claims on capital located abroad. The third column reports the difference between the first two columns, our "adjusted debt" measure.

We measure the current account as the change in the international investment position of a country, expressed as a fraction of GNP. Since IIPs are measured at market prices, the change in the IIP reflects both the within-period transactions which comprise the conventional flow measure of the current account, as well as revaluations in the stock of foreign assets. Figure A2, which plots the conventional measure of the current account and the change in the IIP for each of the countries in our sample, reveals that the contribution of revaluation effects to the change in the IIP is substantial in most countries.

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<sup>23</sup> The final sample of countries is determined by the limited data availability for these series. A complete description of the data is provided in Appendix 2.

## **Current Account Cyclicity in Debtor and Creditor Countries**

We are now ready to examine how the cyclicity of the current account varies with the level of debt of a country. Table 2 presents a first look at the evidence. The first column reports the average level of adjusted debt over the period 1971-93, while the second column reports the time-series correlation of the current account surplus (expressed as a share of GNP) with per capita GNP growth over the same period, for each of the countries in our sample. In six out of seven countries where adjusted debt is positive, the current account is countercyclical (Sweden is the only exception), while in five out of six countries where adjusted debt is negative, the current account is procyclical (Japan is the only exception). This pattern is highlighted in Figure 1, which plots the cyclicity of the current account (on the vertical axis) against the level of adjusted debt (on the horizontal axis). There is a clear negative relationship, and the simple correlation between the two variables is -0.54.

Although highly suggestive, the results in Table 1 should be interpreted with some caution as they pool information within countries. To the extent that country-specific levels of productivity are constant over time, this poses no particular difficulties. However, if changes in productivity are important in the data, the simple time series correlations in Figure 1 may obscure variations over time in the cyclicity of the current account within countries. To address this concern, we adopt the following strategy. First, we pool all country-year pairs of observations and rank them by their adjusted debt. We then divide the sample in two at a particular threshold level of adjusted debt. Then, for the two subsamples, we compute the

cyclicality of the current account for the two subgroups and test whether they are significantly different.<sup>24</sup>

Figures 2(a)-2(d) present the results of this robustness check for various subsamples of the data. In each figure, the bold (solid) line plots the cyclicality of the current account in debtor (creditor) countries for the corresponding level of adjusted debt at which the sample is divided in two, indicated on the x-axis. The dashed line reports the p-value for a test of the null hypothesis that the cyclicality of the current account is equal in the two groups. Figure 2(a) uses data for all countries over the entire period from 1971 to 1993, and reveals that current accounts are clearly procyclical in creditor countries and countercyclical in debtors. Moreover, for a wide range of values of the threshold, this difference is significant at the 5-10 percent level. Figures 2(b),(c) and (d) present the same information for three subsamples of the data. Figures 2(b) and 2(c) restrict the sample to the 1971-81 and 1982-93 subperiods respectively, and reveal that the difference in current account cyclicality is much more pronounced in the latter period. However, if we drop the two years following the 1973 and 1979 oil shocks from the 1971-82 subperiod, as is done in Figure 2(d), the pattern we emphasize re-emerges.

In the theory developed above, output shocks are shared in both debtor and creditor countries, while the differential current account behavior in the two sets of countries arises from the differential investment response to output shocks. In debtor countries, a fraction greater than one of these savings is allocated to domestic capital, while in creditor countries a this fraction is smaller than one. The

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<sup>24</sup> We remove country means from all variables before computing the correlations. We test for equality of current account cyclicality in the two groups as follows: First, we regress the current account on per capita income growth in the two subsamples. Under the assumption that the two point estimators are independent and asymptotically normal, we can construct the usual Wald statistic for the null hypotheses that the slope coefficients are equal in the two subsamples. A rejection of this null hypothesis constitutes evidence that the cyclicality of the current account differs in the two groups of countries.

third and fourth columns of Table 2 provide some rough indicators of these two pieces of the theory. The third column reports the within-country time-series correlation between per capita GNP growth and savings.<sup>25</sup> In all countries, there is a strong positive correlation between savings and per capita income growth at annual frequencies, consistent with the view that at least some portion of shocks to income are saved in order to smooth consumption over time. As in the theory, there is no obvious relationship between the level of debt and the cyclical behaviour of savings.<sup>26</sup> The final column of Table 2 reports the within-country time series correlation between savings and the current account. Consistent with the theory, there is a strong negative relationship between the level of debt of a country and the correlation of savings and the current account. In six out of seven debtor countries, savings and the current account are negatively correlated, while in five out of six creditors, they are positively correlated (Sweden and Japan again are exceptions).

### **Other Explanations for the Debtor/Creditor Distinction**

A notable feature of business cycles in OECD economies is that they tend to be highly correlated across countries.<sup>27</sup> This observation suggests two possible alternative explanations which might account for the difference in current account cyclicity between debtor and creditor countries. First, OECD-wide economic expansions tend to be associated with increases in interest rates. In fact, the time-series correlation between OECD average per capita GNP growth and growth in the six-month LIBOR is 0.55. Thus, it is possible that current accounts are

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<sup>25</sup> Savings is defined as net national savings, expressed as a fraction of GNP.

<sup>26</sup> This of course does not rule out other explanations for the procyclicality of savings. For example, if booms redistribute wealth from individuals with low savings propensities to individuals with high savings propensities, savings would also be procyclical. However, as long as individuals allocate their wealth using investment rules such as the ones discussed in this paper, our effects would still arise.

<sup>27</sup> See Costello (1993) and Kraay and Ventura (1997).

countercyclical in debtor countries only because domestic booms coincide with high present and expected future debt service obligations.

Second, to the extent that countries hold claims on foreign capital, current account fluctuations also reflect domestic and foreign residents' decisions on how much capital to hold abroad. This too can potentially account for the countercyclicality of current accounts in debtor countries. To see why, suppose that, consistent with the notion that they are high-productivity countries, debtor countries tend to invest less abroad than foreigners invest in them. Then, provided that all investors allocate their marginal unit of wealth among assets in the same proportions as their average wealth, favourable income shocks that are correlated across countries will produce current account deficits in debtor countries simply because foreigners purchase more claims on debtor country capital than residents of the debtor country purchase abroad. In our sample, the outward investment of debtor countries was on average 5.6% of GNP, while inward investment in these countries was 9.8%. In creditor countries, the corresponding figures are 15.2% and 11.1%.

To adequately differentiate our theory from these alternatives, we revisit the evidence presented above, conditioning on global shocks such as changes in world interest rates and foreign income. This is done in Table 3 and Figure 3, which report the partial correlation between the current account surplus and domestic per capita GNP growth, controlling for the growth rate of the 6-month LIBOR and the growth rate of OECD per capita GNP excluding the country in question.<sup>28</sup> Now the cross-country correlation between the level of adjusted debt and the cyclicity of the current account remains negative, and is equal to -0.55. Figure 4 reports the results of dividing the full sample of countries into debtors and creditors at various threshold

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<sup>28</sup> A further concern might be that productivity shocks account for a larger share of fluctuations in per capita GNP growth in debtor countries than in creditors. Although there are no a priori reasons to believe in this asymmetry, it is possible that our results are driven by it. We did experiment with controlling for various proxies for productivity shocks, and obtained substantially similar results to those reported here.

levels of debt. The pattern which emerges is similar to that in Figure 2(a). However, we can now only reject the null hypothesis that the cyclicalities of the current account is the same in debtor and creditor countries over a smaller range of threshold levels of debt.

## 5. Concluding Remarks

Using a model with quite conventional ingredients, we have derived the novel prediction that, if investors exhibit constant relative risk aversion and have no labour income, favourable output shocks lead to current account deficits in debtor countries and surpluses in creditor countries. Under these assumptions, the marginal unit of wealth (the income shock) is distributed across assets in the same proportions as the average one. Since by definition the share of a debtor country's wealth devoted to domestic capital exceeds one, an increase in wealth (savings) results in a greater increase in domestic capital (investment), leading to a deficit on the current account. Conversely, in creditor countries the increase in wealth exceeds investment at home, as a portion of this wealth increase is invested abroad. This produces a current account surplus in creditor countries. We have also shown that, if investors' risk aversion varies with wealth and in the presence of labour income, there is a simple rule to determine when a positive output shock leads to a current account deficit: the country's debt has to exceed a threshold that can be either positive or negative, and is zero in the case of constant relative risk aversion and no labour income. We have also provided some suggestive evidence from thirteen OECD countries that is consistent with this prediction.

To make progress one must be willing to make assumptions, and we have not been shy about doing so. Sovereign risk and foreign investment are two important features of real economies that we have left unmodelled here. We feel confident however that our results would survive all but the most extreme versions of models that incorporate these elements. In our opinion, the most glaring omission of this paper is the absence of adjustment costs to investment. In real economies investment is not "bang-bang" as we have assumed here. Abstracting from adjustment costs greatly simplifies the analysis, while permitting us to isolate the



main economic forces at work. The drawback however is that the effects of all these forces are collapsed into a single instant, effectively precluding any meaningful discussion of the dynamic aspects of the current account responses to shocks. We are currently extending the theory to determine how sluggish investment responses to shocks affect the results presented here and, hopefully, derive new results regarding the dynamic aspects of the current account responses to both output and productivity shocks.

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## Appendix 1: Solution Details

### Optimal Consumption and Portfolio Rules

Here we derive the solution to the consumer's problem in the model of Section 3, and note that the solution to the corresponding problem in Section 1 obtains as the special case where  $\lambda_j = \beta_j = 0$ . The representative consumer residing in country  $j$  maximizes (15) subject to the budget constraint (16) and the (correct in equilibrium) belief that  $r$  is constant and  $\pi_j$  follows the dynamics in Equation (2).<sup>29</sup> The Bellman equation for this problem is:

$$\begin{aligned} \rho \cdot V(a_j, \pi_j) = \max_{\langle c_j, x_j \rangle} & \left\{ \ln(c_j + \beta_j) + \frac{\partial V(a_j, \pi_j)}{\partial a_j} \cdot [((\pi_j - r) \cdot x_j + r) \cdot a_j + \lambda_j - c_j] + \right. \\ & \left. + \frac{\partial^2 V(a_j, \pi_j)}{\partial a_j^2} \cdot \frac{1}{2} x_j^2 \cdot a_j^2 \cdot \sigma^2 + \phi \cdot [V(a_j, \pi_j + g(\pi_j)) - V(a_j, \pi_j)] \right\} \end{aligned} \quad (A1)$$

The first order-conditions of this problem are:

$$\frac{1}{c_j + \beta_j} - \frac{\partial V(a_j, \pi_j)}{\partial a_j} = 0 \quad (A2)$$

$$\frac{\partial V(a_j, \pi_j)}{\partial a_j} \cdot (\pi_j - r) + \frac{\partial^2 V(a_j, \pi_j)}{\partial a_j^2} \cdot \sigma^2 \cdot x_j \cdot a_j = 0 \quad (A3)$$

<sup>29</sup> If  $\lambda_j = \beta_j = 0$ , the solution to this problem is correct even if the world economy is not in a steady-state with a constant interest rate.

It can easily be verified that the following value function solves the Bellman equation:

$$V(a_j, \pi_j) = \rho^{-1} \cdot \ln \left( a_j + \frac{\lambda_j + \beta_j}{r} \right) + g(\pi_j) \quad (A4)$$

where  $g(\pi_j)$  does not depend on  $a_j$ . Substituting the derivatives of the value function into the first order conditions (A2) and (A3) yields Equations (17) and (18). These in turn specialize to Equations (5) and (6) for the case of  $\lambda_j = \beta_j = 0$ .

### The World Steady-State

Here we show that, if  $\lim_{J \rightarrow \infty} \frac{1}{J} \cdot \sum_{j=1}^J \lambda_j + \beta_j = 0$ , there exists a steady-state in

which both the world average productivity and world growth rate are constants. Let  $H$  be the set of countries with  $\pi_j = \bar{\pi}$ , and  $L$  be the set of countries with  $\pi_j = \underline{\pi}$ .

Remember that each group contains the same number of countries. Therefore, the

average wealth of countries in the two groups is  $\bar{a} = \lim_{J \rightarrow \infty} \frac{2}{J} \cdot \sum_{j \in H} a_j$  and

$\underline{a} = \lim_{J \rightarrow \infty} \frac{2}{J} \cdot \sum_{j \in L} a_j$ . Also, define  $s = \frac{\bar{a}}{\bar{a} + \underline{a}}$ . Using this notation, we can write the world

interest rate as  $r = s \cdot \bar{\pi} + (1-s) \cdot \underline{\pi} - \sigma^2$ .

Next we show that there exists a distribution of wealth  $s^*$  at which  $ds=0$ . We do so in four steps. First, we note that, except for the cases in which  $\bar{a} = 0$  or  $\underline{a} = 0$ ,

the condition  $ds=0$  requires that  $\frac{d\bar{a}}{\bar{a}} = \frac{d\underline{a}}{\underline{a}}$ . Second, we note that Equation (19), the

assumption that  $\lim_{J \rightarrow \infty} \frac{1}{J} \cdot \sum_{j=1}^J \lambda_j + \beta_j = 0$ , and the fact that a fraction  $\phi \cdot dt$  of countries

change regime each period, jointly imply that:

$$d\bar{a} = \left\{ \left[ \left( \sigma + (1-s) \cdot \frac{\bar{\pi} - \underline{\pi}}{\sigma} \right)^2 + s \cdot \bar{\pi} + (1-s) \cdot \underline{\pi} - \sigma^2 - \rho \right] \cdot \bar{a} + \phi \cdot (\bar{a} - \underline{a}) \right\} \cdot dt + \\ + \left( \sigma + (1-s) \cdot \frac{\bar{\pi} - \underline{\pi}}{\sigma} \right) \cdot \lim_{J \rightarrow \infty} \frac{2}{J} \cdot \sum_{j \in I} a_j \cdot d\omega_j \quad (A5)$$

$$d\underline{a} = \left\{ \left[ \left( \sigma - s \cdot \frac{\bar{\pi} - \underline{\pi}}{\sigma} \right)^2 + s \cdot \bar{\pi} + (1-s) \cdot \underline{\pi} - \sigma^2 - \rho \right] \cdot \bar{a} + \phi \cdot (\bar{a} - \underline{a}) \right\} \cdot dt + \\ + \left( \sigma + s \cdot \frac{\bar{\pi} - \underline{\pi}}{\sigma} \right) \cdot \lim_{J \rightarrow \infty} \frac{2}{J} \cdot \sum_{j \in I} a_j \cdot d\omega_j \quad (A6)$$

Third, we note that, conditional on the  $a_j$ s and given that the shocks  $d\omega_j$  are independent across countries, a straightforward application of the Law of Large

Numbers shows that  $\lim_{J \rightarrow \infty} \frac{2}{J} \cdot \sum_{j \in I} a_j \cdot d\omega_j = \lim_{J \rightarrow \infty} \frac{2}{J} \cdot \sum_{j \in I} a_j \cdot d\omega_j = 0$ . Fourth, it follows that

$ds=0$  if and only if:

$$s \cdot (1-s) \cdot \left[ (1-2 \cdot s) \cdot \left( \frac{\bar{\pi} - \underline{\pi}}{\sigma} \right)^2 + 2 \cdot (\bar{\pi} - \underline{\pi}) \right] + \phi \cdot (1-2 \cdot s) = 0 \quad (A7)$$

An analysis of this equation reveals that there exist a solution  $s^* \in (1/2, 1]$ . Hence, taking this distribution of wealth as an initial condition, the world average productivity and the world interest rate are constant. The reader can easily check that the world growth rate is also constant.

## Appendix 2: Data Sources

This paper uses data on international investment positions (IIPs) reported in the International Monetary Fund's Balance of Payments Statistics Yearbook (5th Edition). Subject to availability, this source reports data on the stocks of various assets held abroad by residents of a country, and the corresponding stocks of domestic assets held by non-residents. These stocks of assets are valued at market prices, and hence changes in these stocks reflect unrealized capital gains and losses which are not captured in the usual flow measure of the current account.

In order to empirically implement our model, we need to distinguish between three components of the IIP: claims on foreign capital held by the residents of a country (outward equity claims), claims on domestic capital held by non-residents of that country (inward equity claims), and net holdings of the international bond. Outward equity claims are measured as outward foreign direct investment plus residents' holdings of corporate equities abroad. Similarly, inward equity claims are measured as inward FDI plus non-residents' holdings of domestic corporate equities. Finally, net bond holdings are proxied by the non-reserves residual of the IIP, which includes net public and private bond holdings and other long- and short-term capital.

Our sample of countries was determined both by data availability and concerns about data quality. We began with a sample of 20 OECD economies.<sup>30</sup> We then checked the overall IIP series for these countries against that reported in Rider (1994), which presents independent estimates of IIPs based on extensive research into national sources. For most countries, these two sources correspond

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<sup>30</sup> Greece, Ireland and Iceland were immediately dropped from the sample due to extremely limited data coverage. The Balance of Payments Statistics Yearbook reports balance of payments data for an aggregate of Belgium and Luxembourg only. This reduces the original sample of 24 OECD economies by four.

quite closely. However, we were forced to drop Belgium/Luxembourg and New Zealand due to major discrepancies between the two sources. Next, we excluded Portugal and Switzerland since IIP data were available only for eight years for each of these countries. Finally, we dropped Denmark, Norway, Turkey from the sample since stock data on the subcomponents of the IIP we required were not available.<sup>31</sup> This resulted in fairly complete series on the IIP and its components for 13 countries between 1970 and 1993. The remaining missing values in the sample were obtained by cumulating the corresponding flow items from the balance of payments in order to obtain a balanced panel of 24 annual observations for each country and series.<sup>32</sup>

The remaining data used in this paper (GNP and net national savings) are drawn from the OECD's national accounts.

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<sup>31</sup> Stock data on equity holdings not available for Norway and Turkey. Stock data on FDI not available Turkey.

<sup>32</sup> 54 out of a total of 312 observations were obtained in this manner, all of them in the early 1970s.



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**Table 1— Debt and Adjusted Debt**

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**(percent of GNP, average, 1970-1993)**

	<b>Debt (1)</b>	<b>Outward Investment (2)</b>	<b>Adjusted Debt (3)=(1)-(2)</b>
<b>Debtor Countries</b>			
Finland	24.3	3.2	21.1
Canada	26.0	13.3	12.7
Australia	16.6	6.6	10.0
Sweden	17.1	8.6	8.5
Austria	8.5	2.4	6.1
Italy	6.5	3.3	3.3
Spain	4.5	1.7	2.8
<b>Creditor Countries</b>			
France	2.2	6.4	-4.2
Japan	-3.2	3.5	-6.7
United States	3.2	11.1	-7.9
Germany	-3.5	5.8	-9.3
United Kingdom	6.3	27.8	-21.5
Netherlands	-0.6	36.3	-36.9
<b>Debtor Average</b>	<b>14.8</b>	<b>5.6</b>	<b>9.2</b>
<b>Creditor Average</b>	<b>0.7</b>	<b>15.2</b>	<b>-14.4</b>

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**Table 2 – Current Account Cyclicity in Debtors and Creditors**

	Adjusted Debt (percent of GNP)	Correlation of Current Account with Per Capita GNP Growth	Correlation of Savings with Per Capita GNP Growth	Correlation of Savings with Current Account
<b>Debtor Countries</b>				
Finland	21.1	-0.02	0.76	-0.07
Canada	12.7	-0.31	0.55	-0.12
Australia	10.0	-0.04	0.42	-0.03
Sweden	8.5	0.32	0.48	0.31
Austria	6.1	-0.07	0.58	-0.23
Italy	3.3	-0.34	0.50	-0.11
Spain	2.8	-0.27	0.56	-0.18
<b>Creditor Countries</b>				
France	-4.2	0.05	0.62	0.05
Japan	-6.7	-0.17	0.24	-0.29
United States	-7.9	0.25	0.28	0.54
Germany	-9.3	0.19	0.50	0.01
United Kingdom	-21.5	0.02	0.46	0.00
Netherlands	-36.9	0.47	0.62	0.14
<b>Debtor Average</b>	<b>9.2</b>	<b>-0.10</b>	<b>0.55</b>	<b>-0.06</b>
<b>Creditor Average</b>	<b>-14.4</b>	<b>0.13</b>	<b>0.45</b>	<b>0.07</b>
<b>Correlation w/ Adjusted Debt</b>		<b>-0.54</b>	<b>0.20</b>	<b>-0.26</b>

Figure 1: Current Account Cyclicity in Debtors and Creditors

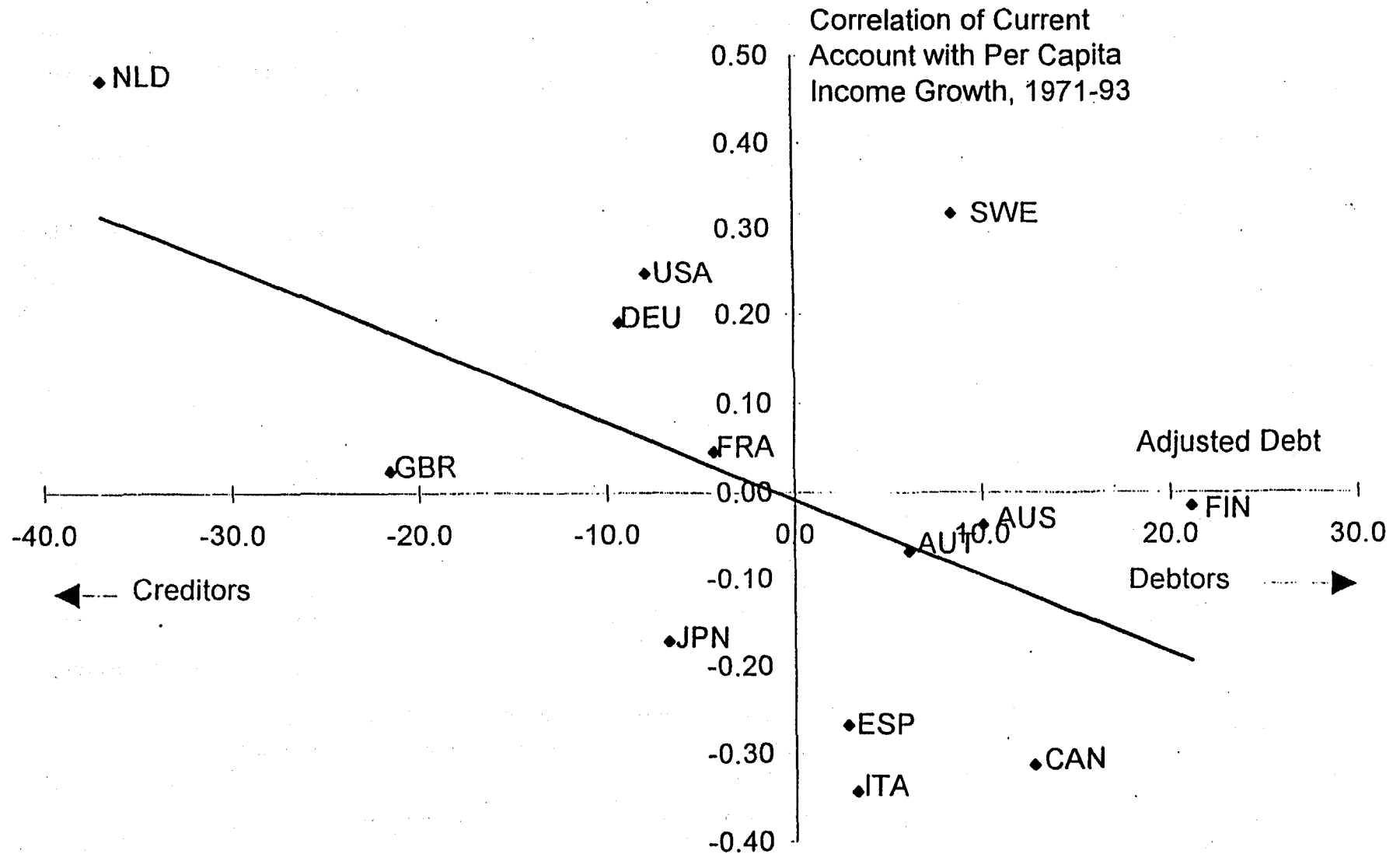


Figure 2(a) -- Cyclicalities of Current Account  
(1971-1993)

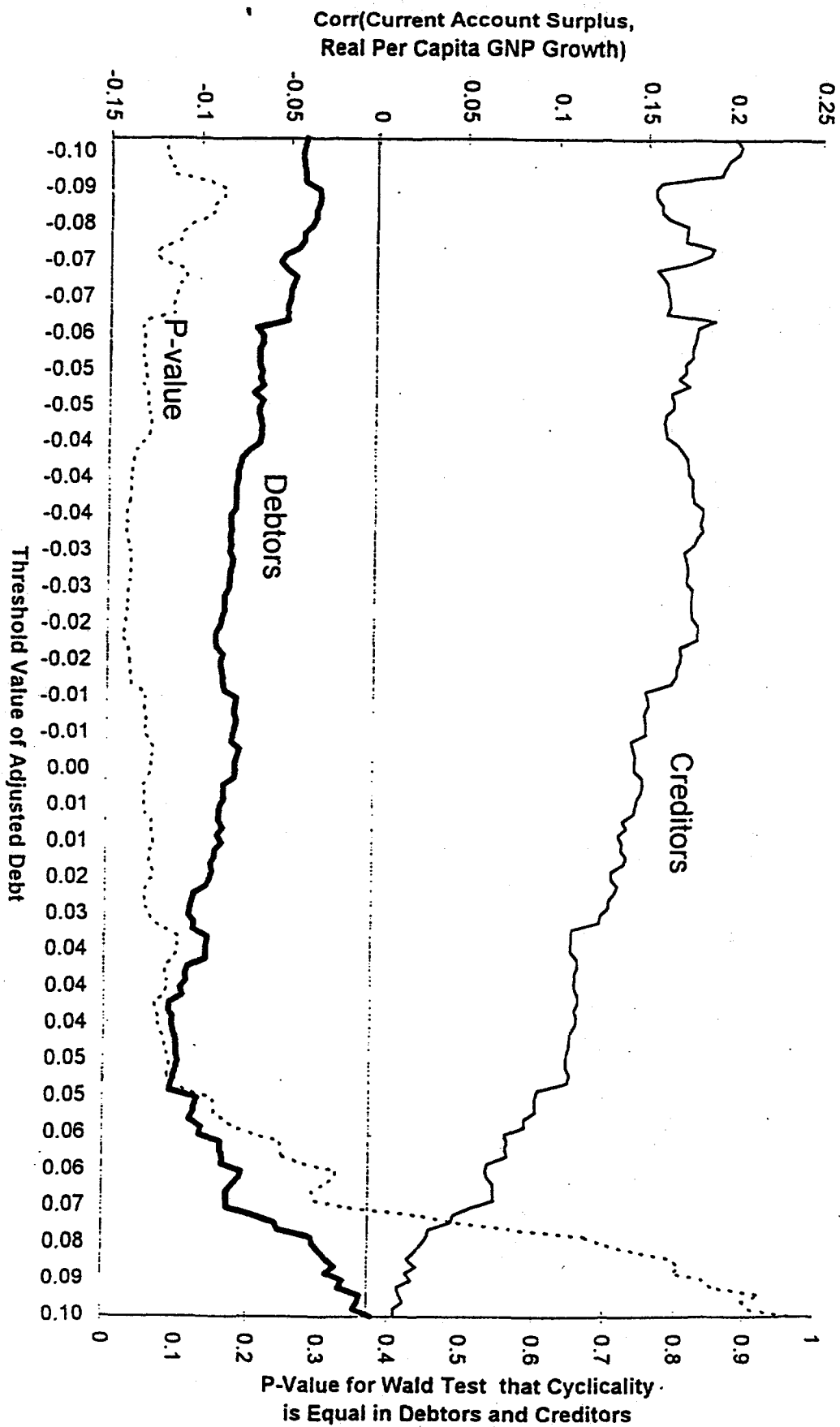
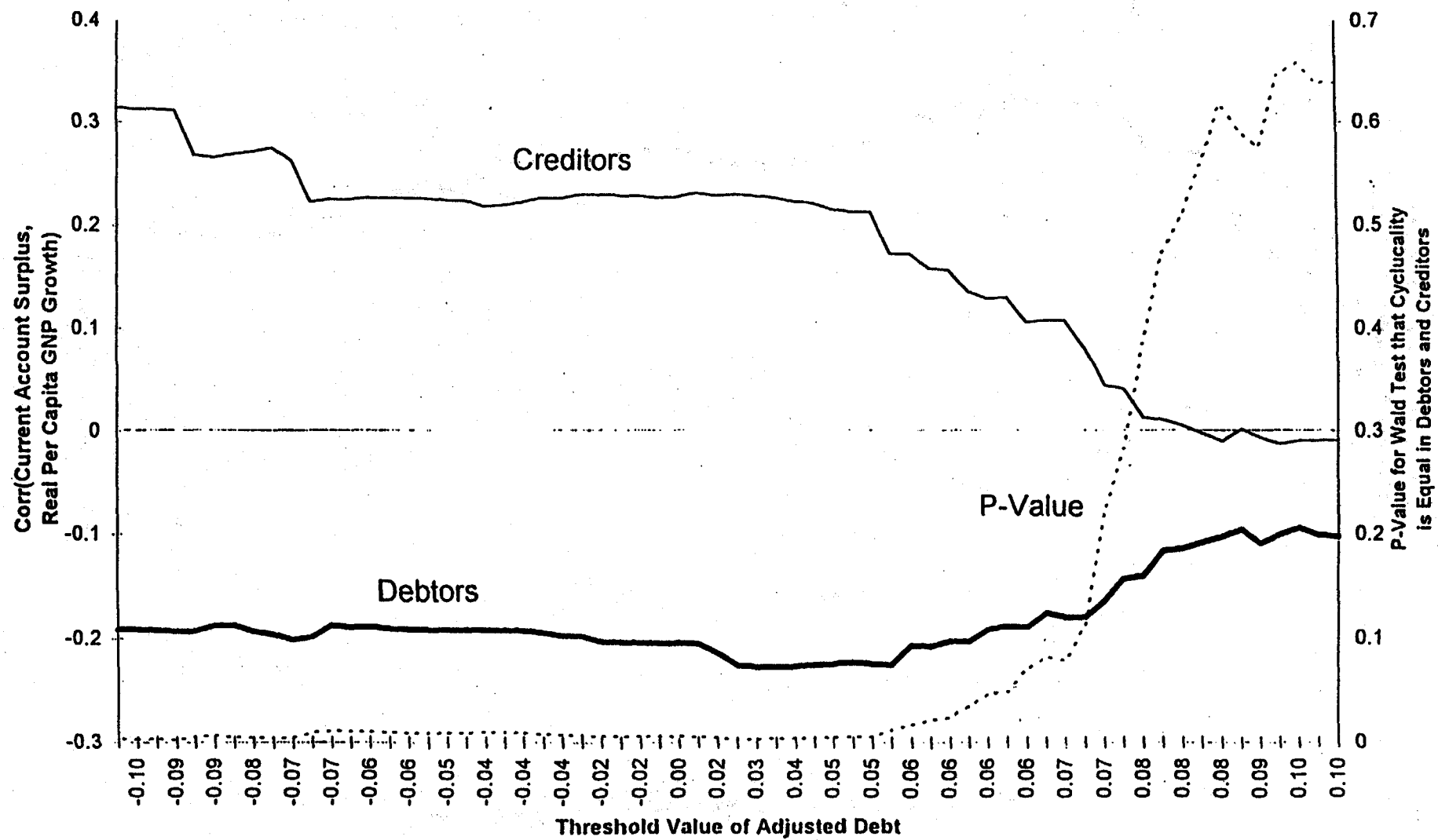


Figure 2(b) -- Cyclicity of Current Account  
(1982-93)



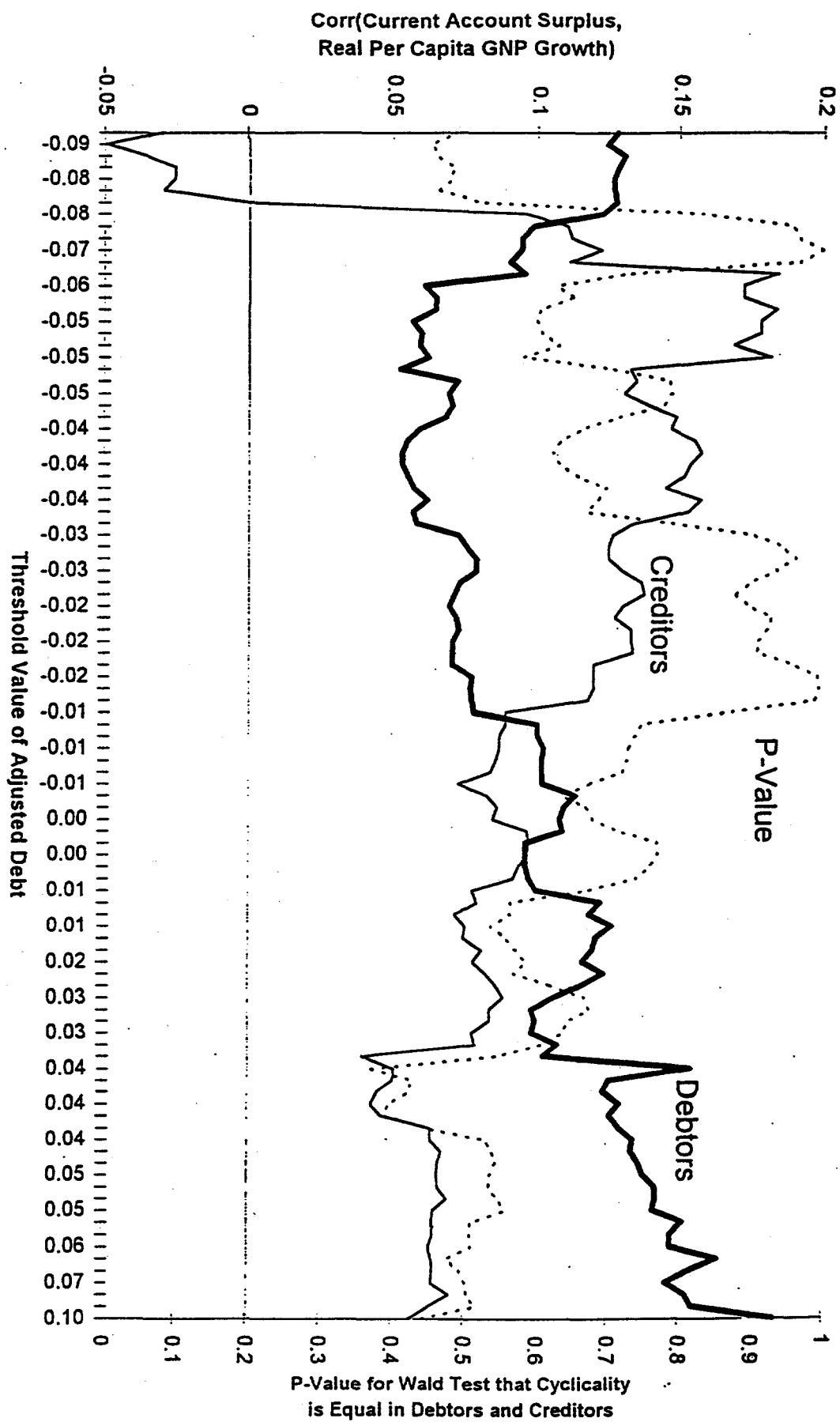


Figure 2(c) --Cyclicality of Current Account  
(1971-82)

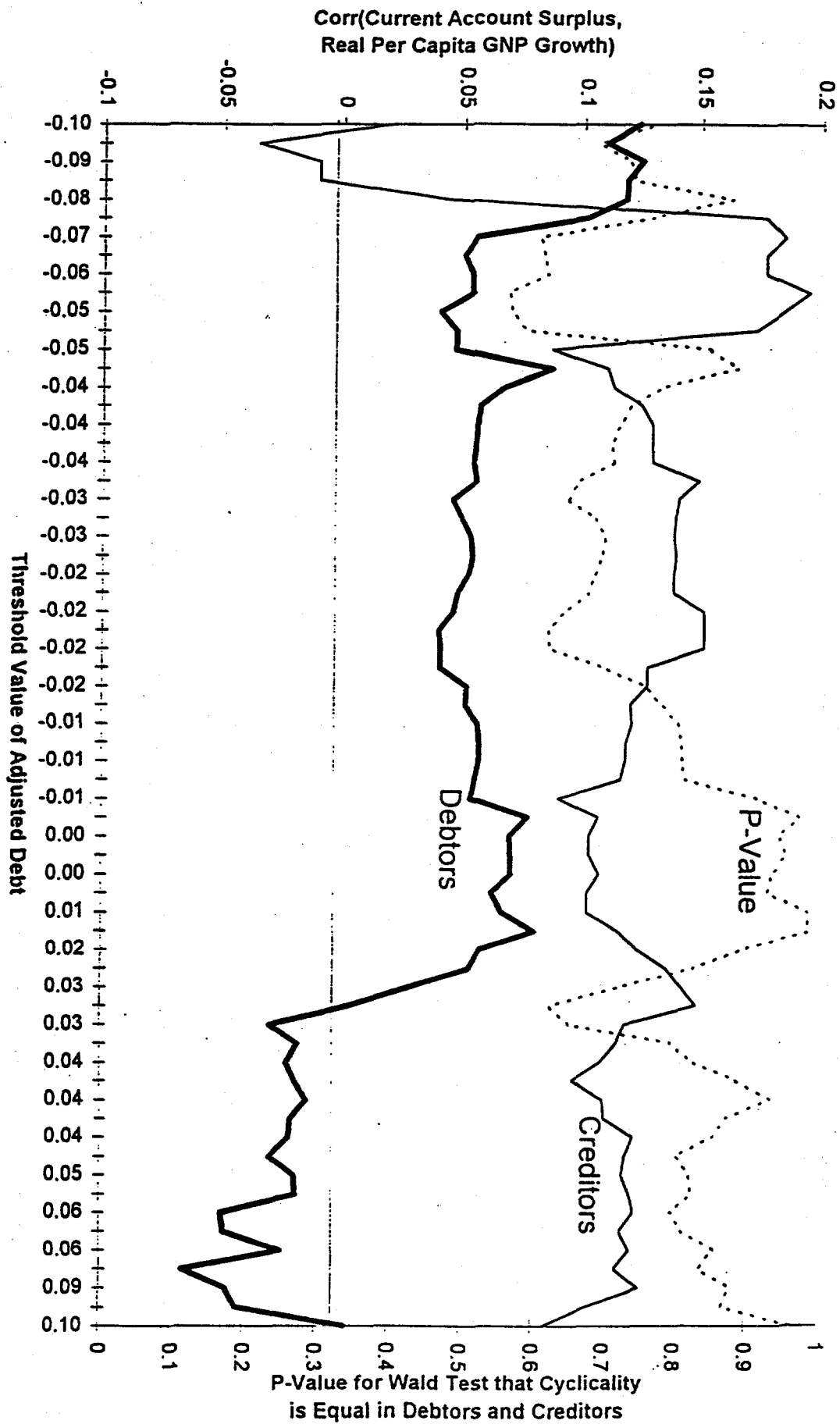
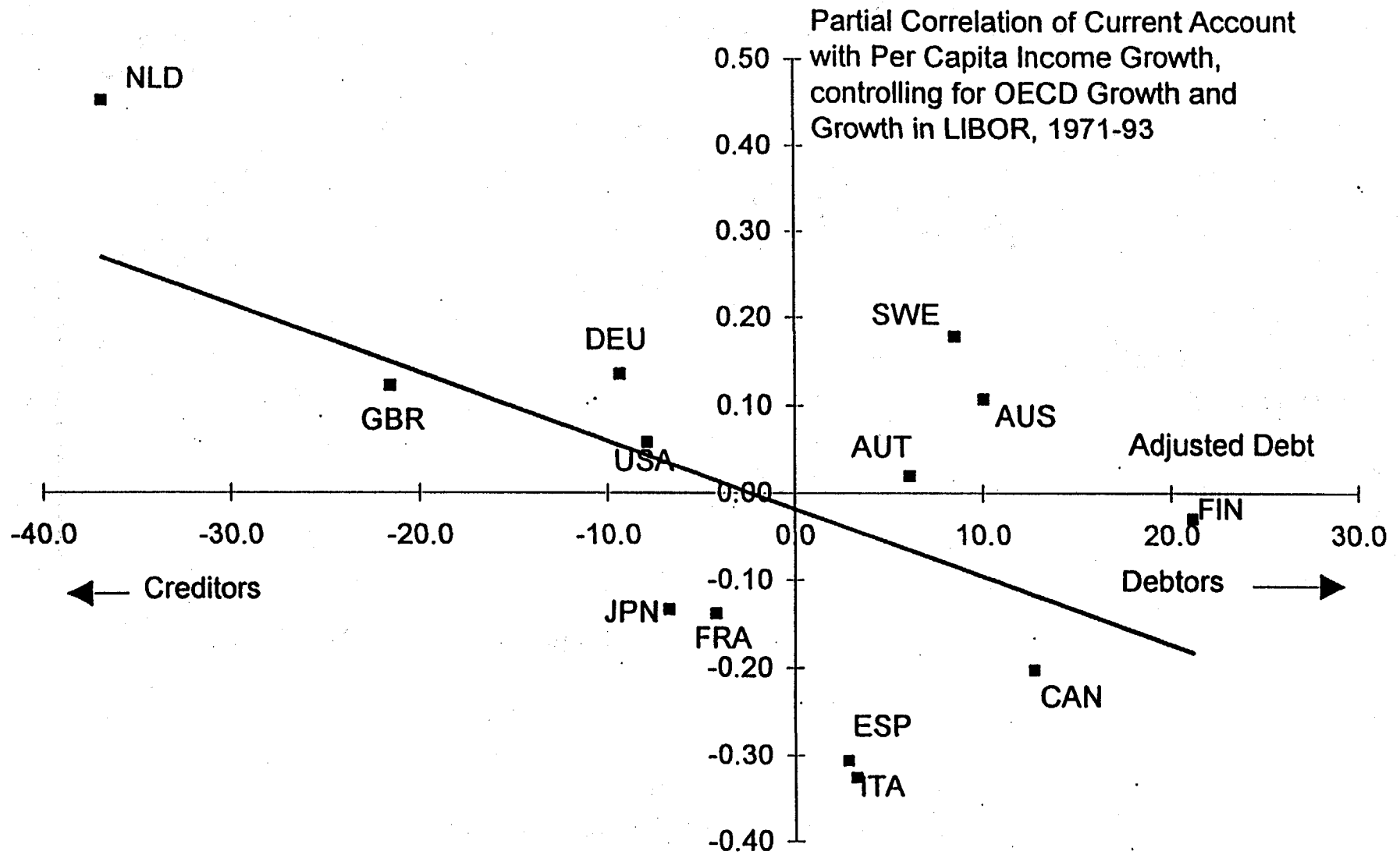
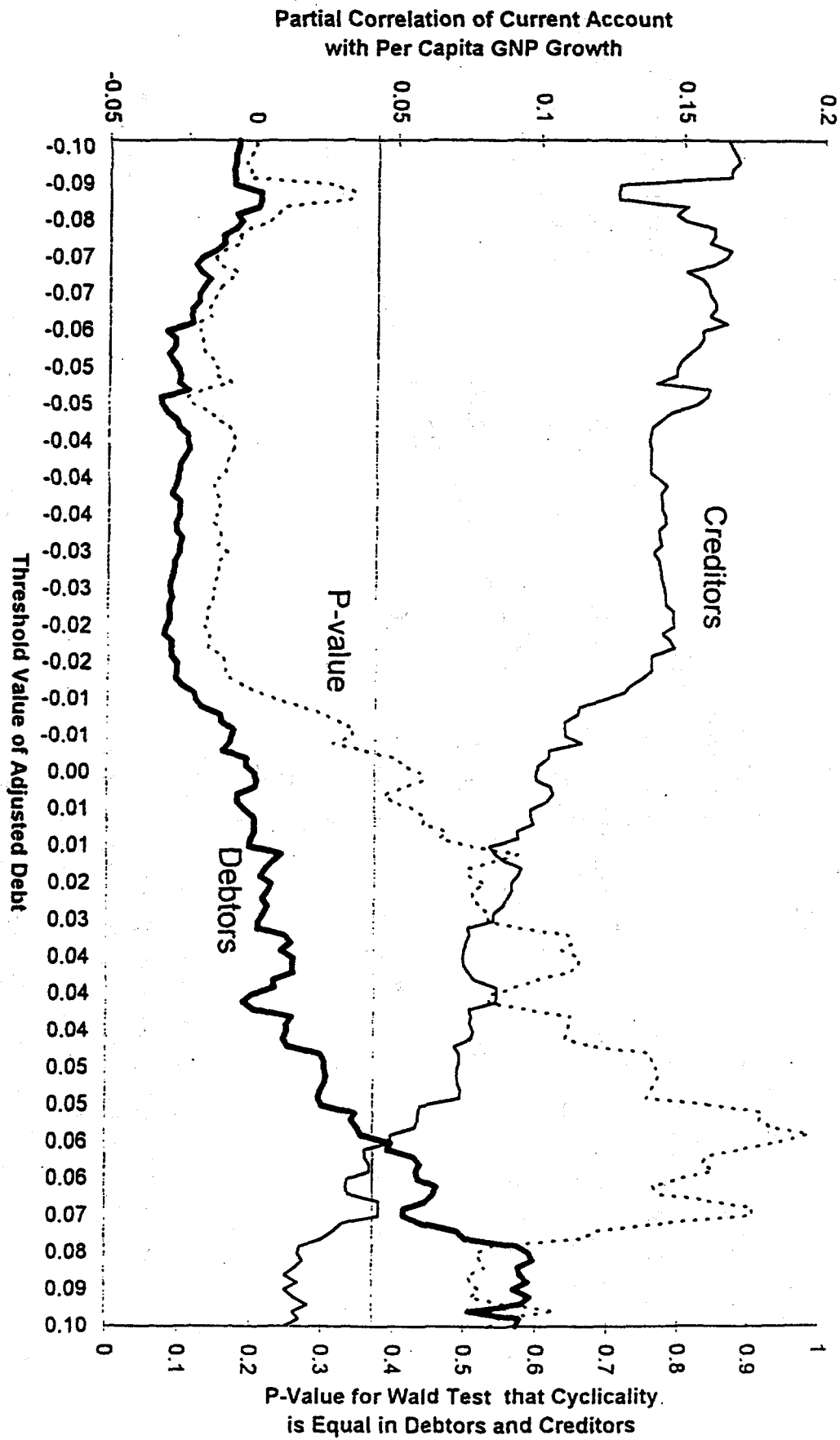


Figure 2(d) -- Cyclicalities of Current Account  
(1971-82, Excluding Oil Shock Years)

**Figure 3: Current Account Cyclicity Controlling for Global Shocks**







**Figure 4 -- Cyclicalities of Current Account  
Controlling for Global Shocks (1971-1993)**

Figure A1: Debt and Adjusted Debt

— Adjusted Debt/GNP  
— Debt/GNP

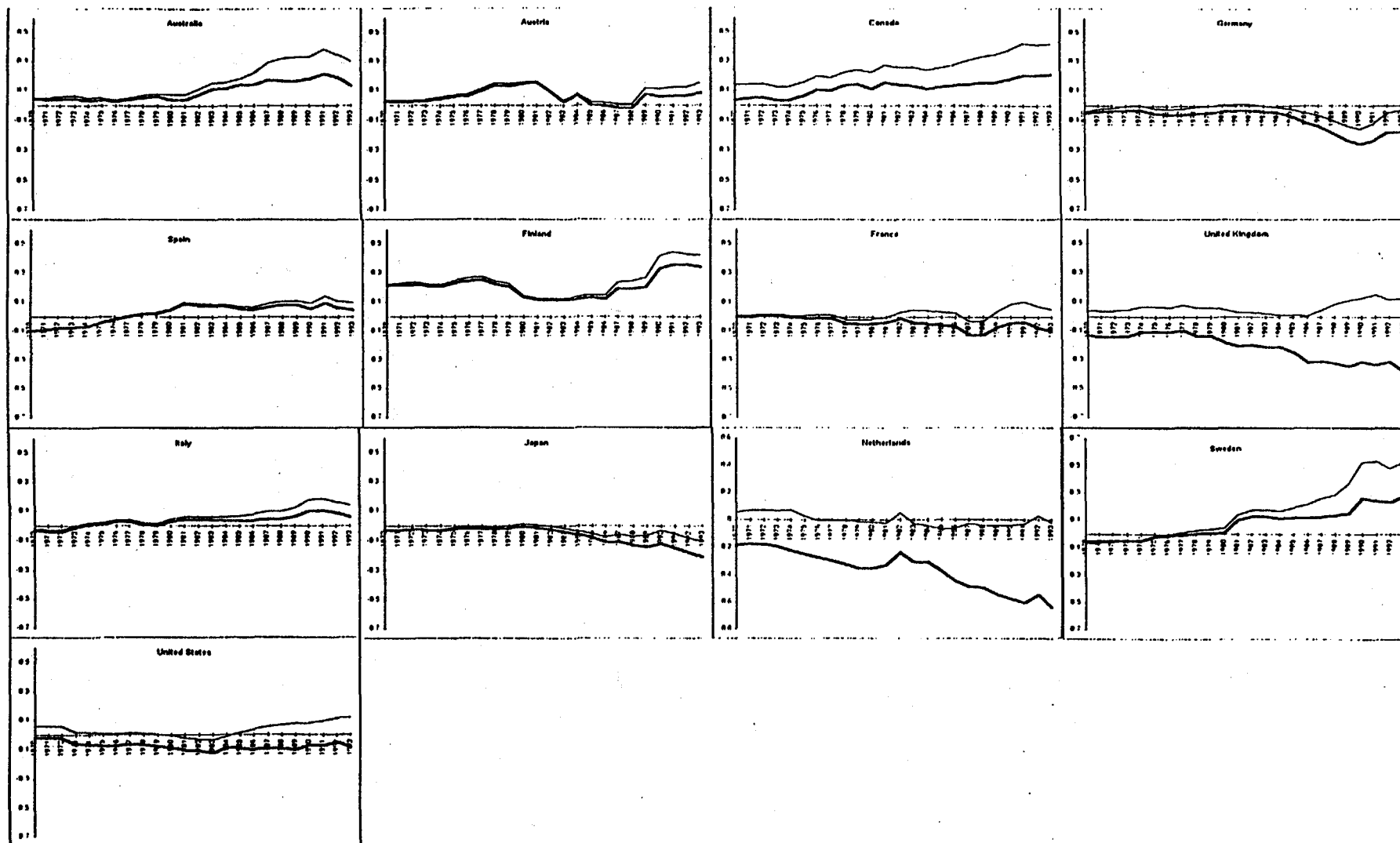
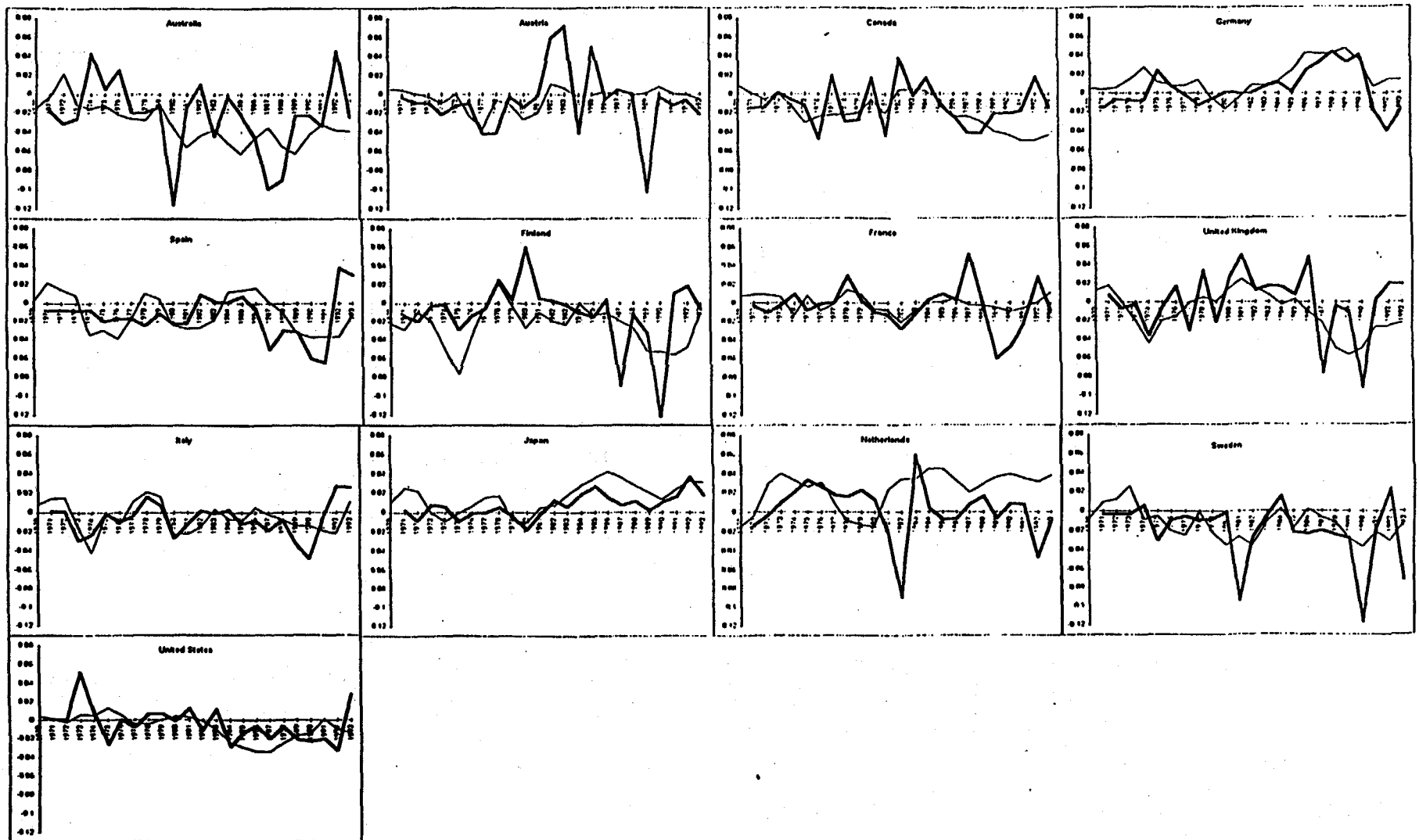


Figure A2: Alternative Measures of the Current Account

— (Change in International Investment Position)/GNP  
 — (Conventional Flow Measure of Current Account Surplus)/GNP





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